

Extraction process of palm kernel cake as a source of mannan for feed additive on poultry diet

M Tafsir¹, N D Hanafi¹ and E Yusraini²

¹. Animal Science Study Program, Faculty of Agriculture, University of Sumatera Utara, North Sumatera, Indonesia

². Food Science and Technology Study Program, Faculty of Agriculture, University of Sumatera Utara, North Sumatera, Indonesia

Email : martafsin@yahoo.com

Abstract. Palm Kernel Cake (PKC) is a by-product of palm kernel oil extraction and found in large quantity in Indonesia. The inclusion of PKC on poultry diet are limited due to some nutritional problems such as anti-nutritional properties (mannan). On the other hand, mannan containing polysaccharides play in various biological functions particularly in enhancing the immune response and to control pathogen in poultry. The research objective to find out the extraction process of PKC and conducted at animal nutrition and Feed Science Laboratory, Agricultural Faculty, University of Sumatera Utara. Various extraction methods were used in this experiment, including fraction analysis used 7 number sieves, and followed by water and acetic acid extraction. The result indicated that PKC had different particle size according to sieve size and dominated by particle size 850 μm . The analysis of sugar content indicated that each particle size had different characteristic on treatment by hot water extraction. The particle size 180-850 μm had higher sugar content than coarse PKC (2000-3000 μm). The total sugar content were recovered vary between 0.9-3.2% from PKC were extracted. Treatment grinding method followed by hot water extraction (100-120 $^{\circ}\text{C}$, 1 h) increased total sugar content than previous treatments and reach 8% from PKC were extracted. Utilisation acetic acid decreased the total amount of total sugar from PKC were extracted. It is concluded that treatment by hot temperature (110-120 $^{\circ}\text{C}$) for 1 h show highest yield to extract sugar from PKC.

1. Introduction

Palm kernel cake (PKC) is a byproduct from industrial processing and in Indonesia, PKC availability is high. Production of fresh fruit bunches of oil palm Approximately 12.5 to 27.5 tons / ha, and about 2 percent is palm kernel cake as by product [1]. Utilisation of PKC as potential feed reported on ruminant diet [2,3], chicken [4], even fish [5]. One limiting factor Utilisation of PKC especially for monogastric animal is high fiber content and its dominant component is a form of mannose that reach 56.4% of total cell walls and dominated by β -mannan [6].

The content of the high mannan as well as the limiting factor may also be regarded as the potential to earn as a prebiotic feed additives that will improve the health of livestock. There was supposed that there are similarities between the PKC with mannanoligosaccharides (MOS) that will improve the health and the immune system of poultry [7]. The research [8] using mannan derived from the hydrolysis of guar gum (*Cyamopsis tetragonolobus*) containing galactomannan with a molecular



weight of about 20 000 Da. Another potential that can be used as a source of mannan is PKC. So far, the PKC is only used as one source of feed, but according to this potential can be increased into raw materials for feed additives.

On the other hand, microbes such as viruses or bacteria potentially harmful to animals that can be found in air, food or water. The bacteria that often contaminate chicken, either at the time of hatching, enlargement and postharvest is groups *Salmonella* sp. The bacteria will affect the health of livestock will also affect the food safety aspects. Several attempts have been made to overcome these problems such as vaccination, sanitation or the use of antibiotics. The effort is in addition to having many benefits also have limitations, for example to antibiotics now found several strains of bacteria that are resistant to antibiotics.

A new approach to prevent microbial infections found in recognition of the importance of the process of attachment of the digestive tract. It is known that type 1 fimbriae are sensitive to mannan plays role in the attachment of pathogenic microbes. Bacteria such as *Salmonella*, *E. coli* and *Vibrio cholera* have lectins on the cell surface that is specific to the mannan, thus mannan can inhibit the process of attachment harmful microbes in the digestive tract [9]. Another capability of MOS is able to stimulate the immune system and this effect also plays a role in the fight against bacteria *Salmonella* [10,11]. MOS can affect the immune system by stimulating the secretion of mannan-binding protein from binding liver capsule invading bacteria. Other studies show that MOS stimulates the immune system by enhancing the phagocytic activity of macrophages and increased levels of Ig (immunoglobulin). Furthermore the immune cells in the GALT (gut associated lymphoid tissue) to detect the presence of microbes due to their unique molecule called PAMP (pathogen-associated molecular pattern) which will further activate the immune system [12].

The objectives of this study is find out the source of mannan from PKC. So far, the PKC is only used as one source of feed, but with this potential can be increased into raw materials for feed additives. According to this background, we are interested in studying the production process and application of the PKC as as feed additives (feed additive) in poultry. So far, several commercial companies using materials from *Saccharomyces cerevisiae* as a raw material. Use of PKC can replace the material with a much cheaper price and high availability in Indonesia. The study on the extraction process of palm kernel cake is still limited, so that the research was conducted.

2. Materials and Methods

Combination treatment will be applied to obtain the most effective and efficient in extraction of PKC become source mannan that can be applied as feed additives on poultry diet.

2.1. Materials

The main ingredient needed is PKC derived from palm kernel oil processing plant owned by PTPN IV. Other materials mainly of chemicals obtained from a commercial company. The main equipment to be used is a water bath shaker, spectrophotometer, and grinder.

2.2. Method

Palm Kernel Cake obtained from the industry were separated using a sieve (screen) which aims to separate the rest of the crushed shells during the process of making palm kernel oil. Combination treatment will be applied to obtain the most effective and efficient in overhauling the structure of the material PKC become source of mannanoligosaccharides (MOS). The treatment is a combined treatment will be given in the form of extraction, the optimum temperature, and duration of incubation. The extraction process is done by using a solvent with a 1:10 ratio. Total PKC used as much as 4 grams for each experimental unit. Further stages performed using hot water extraction (hot water extraction; 121 °C, 15 minutes) that is using an autoclave. The process followed by centrifugation

(4200 rpm; 15 min; 10 °C). The next supernatants were collected and measured the total amount of sugar. The content of total sugar was measured using the reagent of concentrated sulfuric acid and phenol 5% was then measured using a spectrophotometer at a wavelength of 490 nm with D-glucose as standard [13].

3. Results and Discussion

3.1. Screening Process

The extraction stage started with screening of the PKC aimed at getting some fraction of its potential and gain the properties of the content of total sugar. Screening results are presented in table 1.

Table 1. Proportion of BIS based on particle size

Fraction	Sieve number	Particel size (µm)	Proportion (%)
1	5	4000	1.5
2	10	2000	25.5
3	20	850	32.5
4	30	600	15.0
5	40	425	4.0
6	50	300	6.5
7	80	180	15.0
Total			100.0

The images for each faction presented in the following figure:





Figure 1. Appearance of palm kernel cake fractions based on particle size

The method used for the total amount of sugar is using phenol reagent and sulfuric acid. Observations were made using a spectrophotometer that is read at a wavelength of 490 nm. Observations on the content of total extractable sugar are presented in the following table:

Table 2. Total sugar content of each fraction PKC

Fraction PKC	Total sugar	
	g	%
1	0.1821	0.91
2	0.3762	1.88
3	0.5699	2.85
4	0.6493	3.25
5	0.5147	2.57
6	0.3420	1.71
7	0.5215	2.61

Table 2 showed that the total extractable sugar ranges between 0.91 - 3.25% of the PKC were extracted. The range is still relatively small, considering the type of solvent used is only using aquadest. The results of this stage was to get answers in fractions which obtained the best total sugars. Good results obtained in fraction 3 and so on. These results became the early references to perform an

extraction process using materials that have been filtered by sieve size No. 10 or equivalent with a particle size of less than 850 μm .

3.2. Effect of grinding, acetic acid and temperature on total extractable sugar

Improvements continue to do the extraction process to obtain a high yield of mannan contained in the PKC. Results of previous showed at around 0,9-3.2% of PKC. Further treatment provided through several stages: Grinding size using diskmill on materials that have been screened to a particle size of 850 μm and the utilisation of acetic acid (1 and 2%) and a higher temperature (110; and 120 $^{\circ}\text{C}$) with a longer time (1 h). The results are presented in the following figure:

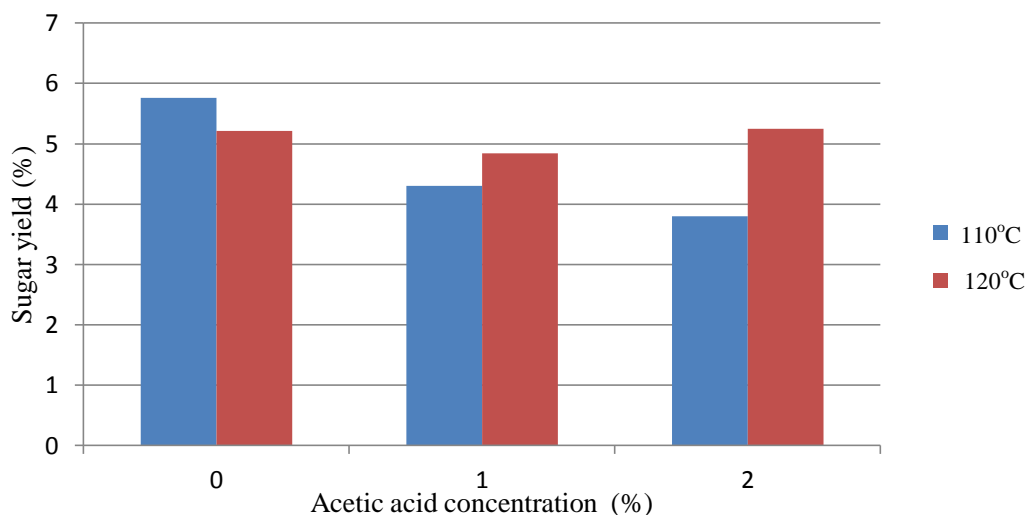


Figure 2. Effect of acetic acid and temperature on total extractable sugar

The figures above showed the total amount of sugar extracted from PKC. The use of high temperatures (110 and 120 $^{\circ}\text{C}$) for one hour, combined with a particle size reduction PKC has raised a high yield of total sugar. Research results in previous stages showed the highest rate was 3.2%, whereas at this stage it reached 8.7%, and the yield is higher than reported [11]. Referring to the results of research which obtained the data content of total ADF 31.7% and total sugar component of 73% [6], so that the estimated number of potential sugar component of 23.1%, then the results of this study indicate that the total sugar were extracted reached 37%.

The utilisation of acetic acid to the level of 2% turned out to show the total amount of extractable sugar relative decline. It shows that the use of acid with a high temperature condition can destruct components of sugar extracted. further studies which we will do is the preparation to readings sugar component by using HPLC (high performance liquid chromatography).

4. Conclusion

Palm kernel cake extraction process can be done by using the PKC that has been filtered by the smaller size of 850 μm . Grinding size reduction followed by hot water extraction may increase the total amount of sugar extracted approaching 8% of the total PKC. The utilisation of acetic acid to obtain extractable sugar of PKC does not exceed 1% concentration.

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